

Using NASA Remotely Sensed Data to Help Characterize Environmental Risk Factors for National Public Health Applications

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Goals and Objectives

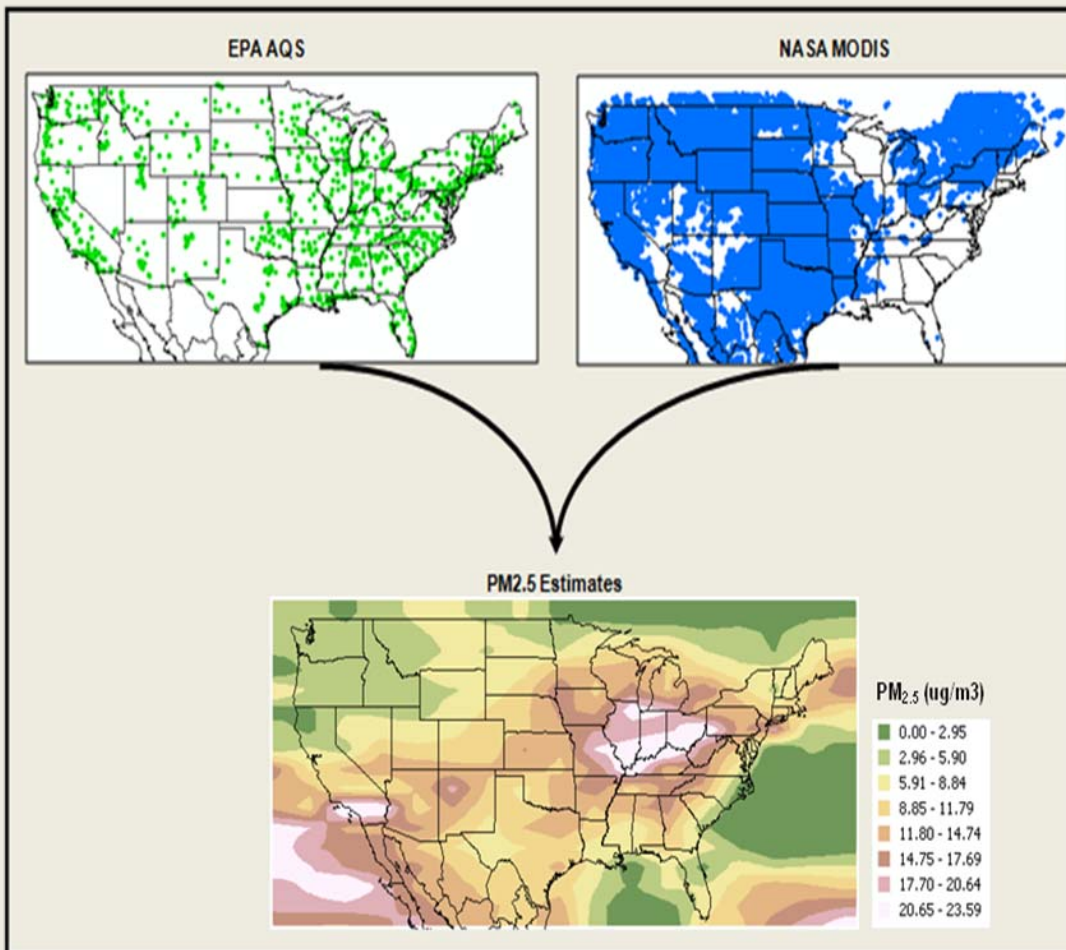
- **This project has dual goals in decision-making activities**
 - Providing information to decision makers about associations between environmental exposures and health conditions in a large national cohort study
 - Enriching the CDC Wide-ranging Online Data for Epidemiologic Research (WONDER) system by integrating environmental exposure data
- **Develop daily high-quality spatial data sets of environmental variables for the conterminous U.S. for the years 2003-2008 utilizing NASA data (Objective 1)**
 - Fine Particulates (PM_{2.5}) (NASA MODIS and EPA AQS)
 - Land Surface Temperature (NASA MODIS)
 - Solar Insolation and Heat-related Products (Reanalysis Data)
- **Link these environmental variables with public health data from a national cohort study and examine environmental health relationships (Objective 2)**
 - Cognitive Function
 - Hypertension
- **Make the environmental datasets available to public health professionals, researchers and the general public via the CDC WONDER system (Objective 3)**

National Environmental Datasets

(Objective 1)

Fine Particulate Matter (PM_{2.5})

- Estimated ground-level PM_{2.5} from MODIS AOD using published regression equations per EPA region per season (Zhang et al., 2009)
- Combined with EPA PM_{2.5} data from the AQS for 2003-2008
- Modified and ran MSFC Surfacing Algorithm (Al-Hamdan et al., 2009, 2012) to produce continuous spatial surfaces of daily PM_{2.5} for the contiguous US for 2003-2008

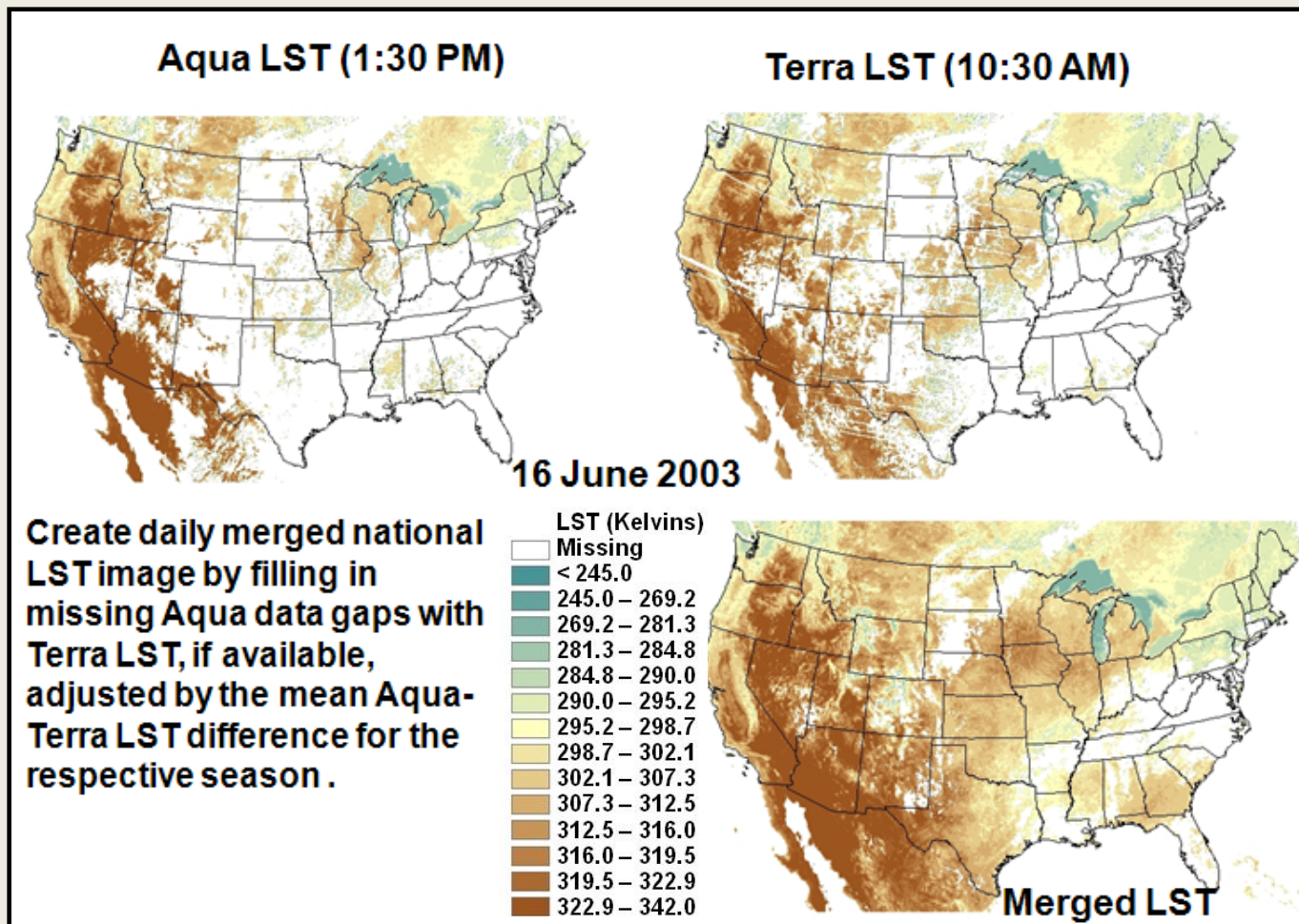


PM_{2.5} on July 14, 2003

(10 km spatial resolution)

Land Surface Temperature (LST)

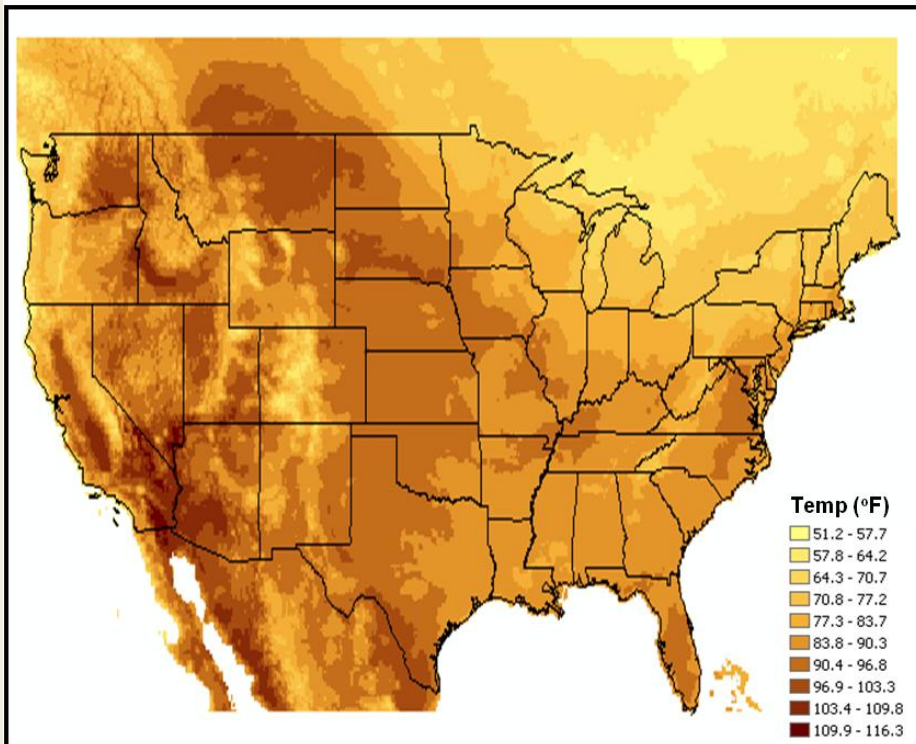
- Aqua and Terra daytime & nighttime data for 2003-2008 were processed
- Aqua-Terra differences were computed by season for 2003-2008
- Aqua data gaps were filled with Terra-adjusted LST (if available) by mean seasonal difference
- National merged Aqua-Terra daily LST dataset were generated for 2003-2008 for day & night (Crosson et al., 2012)



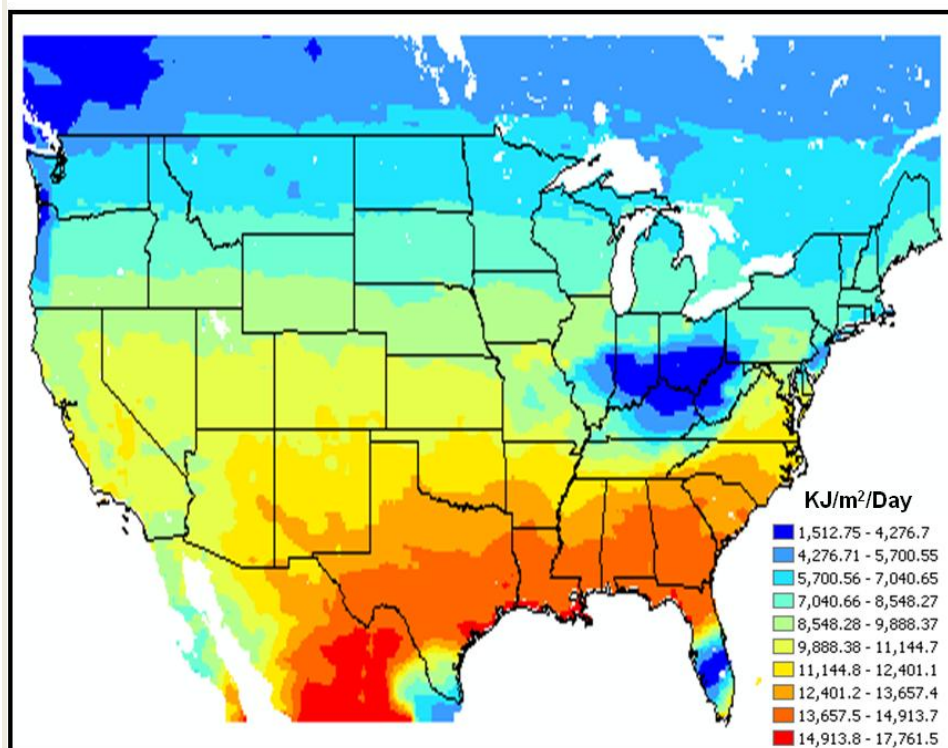
Heat and Solar Insolation

- NLDAS hourly forcing data (air temperature, solar radiation, specific humidity, atmospheric pressure) for the 2003-2008 period were processed
- Daily statistics of Maximum Air Temperature, Minimum Air Temperature, Maximum Heat Index, and Total Solar Insolation were computed for 2003-2008

NLDAS Max Air Temperature on July 15, 2008



NLDAS Solar Insolation on January 1, 2008

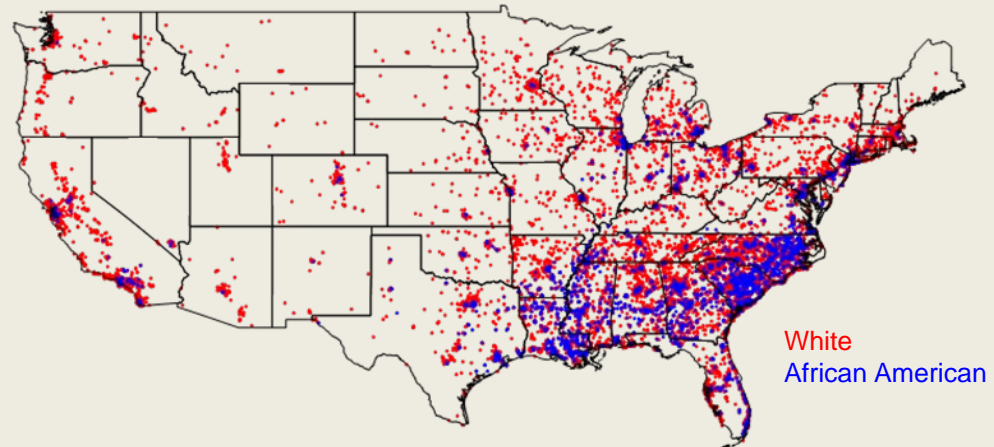


(12 km spatial resolution)

Environmental Health Data Linkage (Objective 2)

REasons for Geographic And Racial Differences in Stroke (REGARDS) Study Population

- Longitudinal population-based cohort of over 30,000 volunteers age 45 and older
- Racial representation
 - 42% African American
 - 58% white
- Sex representation
 - 45% male
 - 55% female
- Geographic representation
 - 21% from the buckle of the stroke belt
 - 35% from the stroke belt
 - 44% from the rest of the contiguous US
- Successfully transferred from UAB to NASA/MSFC
 - BAA as per HIPPA Regulations
 - Data Encryption



Data Linkage for Biostatistical Analyses

- Link in a GIS the estimates of the PM_{2.5}, Solar Insolation, and Air Temperature with health data from all participants in the REGARDS study on the individual level at the geographic coordinates of their residences
- Sort the environmental data by participant ID, and merge in with the corresponding health data from the REGARDS database
- Determine whether exposures to these environmental risk factors are related to cognitive decline and other health outcomes such as hypertension, inflammation, and stroke

Participant ID	Lat	Lon	Day1 Solar Insolation (KJ/m ² /Day)	Day2 Solar Insolation (KJ/m ² /Day)	Day3 Solar Insolation (KJ/m ² /Day)	Day365 Solar Insolation (KJ/m ² /Day)
1	99.045	-87.105	7950	8941	8945		7850
2	99.055	-89.036	7401	8501	8412		7501
3	99.065	-86.212	8001	7015	8251		8401
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30200	99.075	-87.855	15650	11402	15650		10750

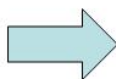
Simulated example of the linked data set consisting of participant ID and the associated NLDAS solar insolation

Data Dissemination via CDC WONDER (Objective 3)

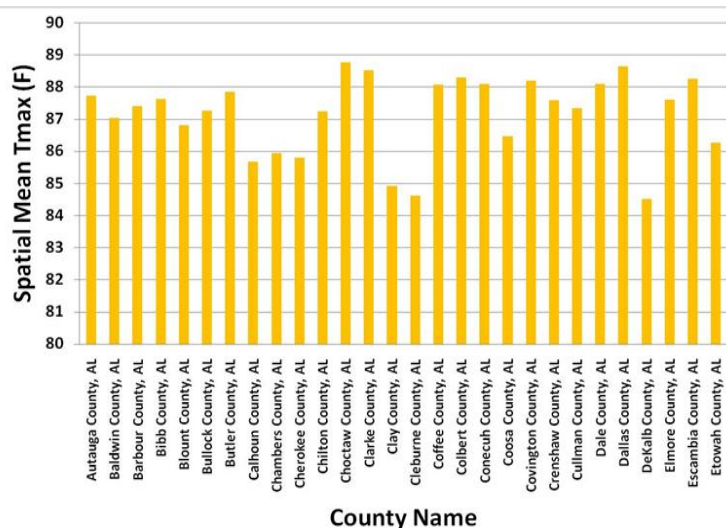
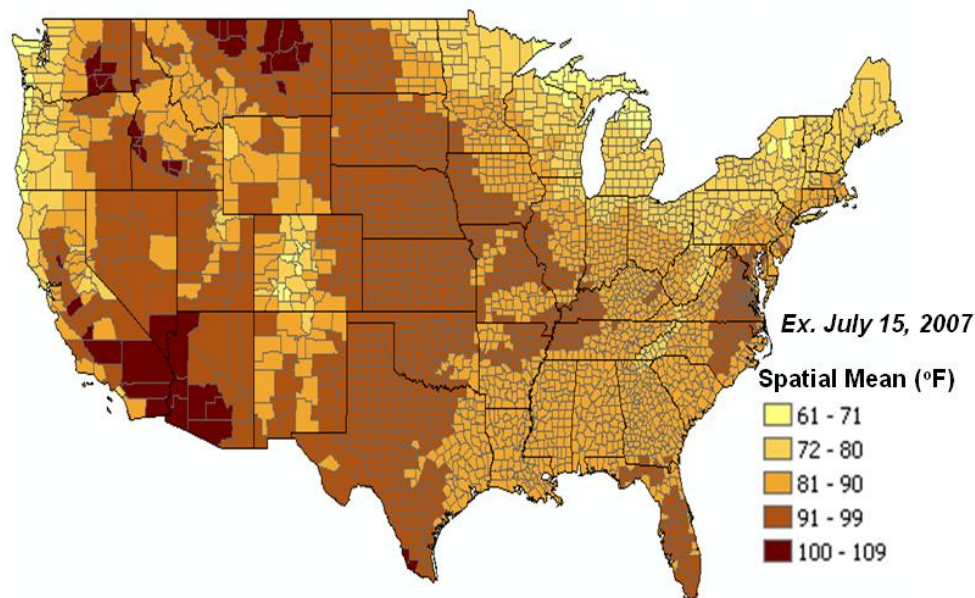
Data Dissemination via CDC WONDER

Tabular Grid-level Daily Data

Grid Cell ID	County, State	FIPS	Day1 Tmax (°F)	Day2 Tmax (°F)	Day3 Tmax (°F)	Day365 Tmax (°F)
1	Kern, CA	06029	71	74	66		70
2	Kern, CA	06029	70	72	67		69
3	Kern, CA	06029	72	73	66		72
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103936	Aroostook, ME	23003	35	31	32		34



Examples of County-level Spatial and Temporal Statistics (Map and Chart) as provided by CDC-WONDER real-time data queries



County	Avg Daily Max Air Temperature(F) # of Observations Range Standard Deviation
Autauga County, AL (01001)	87.85 11 (87.20 to 88.40) 0.43
Baldwin County, AL (01003)	85.82 26 (84.30 to 87.20) 0.61
Barbour County, AL (01005)	86.04 14 (85.50 to 86.60) 0.37
Bibb County, AL (01007)	86.92 9 (86.40 to 87.50) 0.31

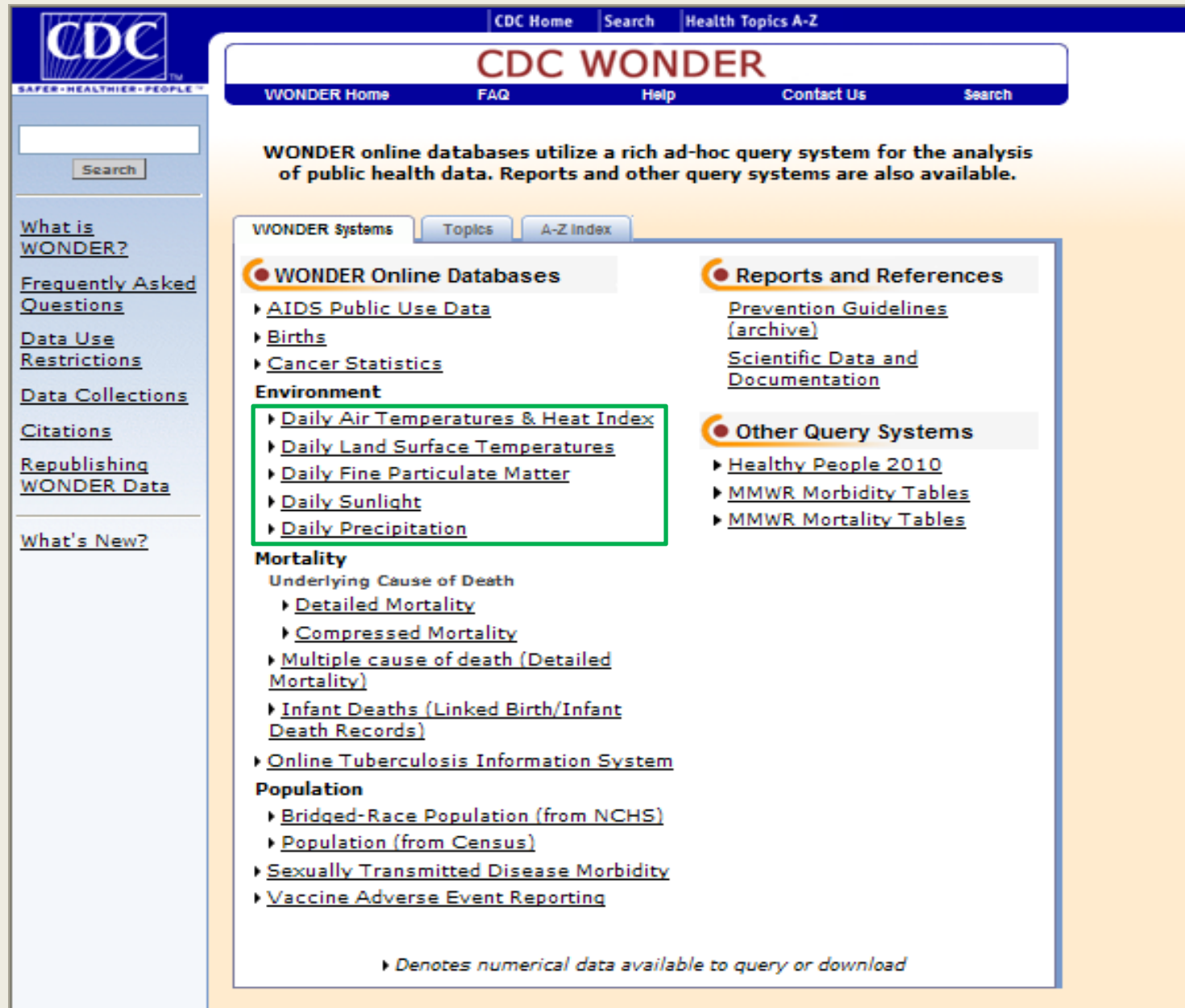
➤ Environmental exposure datasets will be made available to public health professionals, researchers and the general public via WONDER, where they can be aggregated to the county-level or higher as per users' need

➤ Users are able to spatially and temporally query datasets and create county- and higher-level maps and downloadable statistical tables and charts of data across the *contiguous* U.S.

➤ Enabling easy linkage of the environmental exposure data with other health data available via CDC WONDER

CDC WONDER Main Web Page

<http://wonder.cdc.gov/>



The screenshot shows the CDC WONDER Main Web Page. The page has a blue header with the CDC logo and navigation links: CDC Home, Search, and Health Topics A-Z. Below the header is a white box with the text "CDC WONDER" in red. Underneath this is a blue navigation bar with links: WONDER Home, FAQ, Help, Contact Us, and Search. The main content area is white and features a search bar on the left with a "Search" button. To the right of the search bar is a paragraph: "WONDER online databases utilize a rich ad-hoc query system for the analysis of public health data. Reports and other query systems are also available." Below this paragraph are three tabs: "WONDER Systems", "Topics", and "A-Z Index". The "WONDER Systems" tab is selected. The content under this tab is organized into three columns. The first column is titled "WONDER Online Databases" and lists: AIDS Public Use Data, Births, Cancer Statistics, Environment, Daily Air Temperatures & Heat Index, Daily Land Surface Temperatures, Daily Fine Particulate Matter, Daily Sunlight, and Daily Precipitation. The second column is titled "Reports and References" and lists: Prevention Guidelines (archive), Scientific Data and Documentation. The third column is titled "Other Query Systems" and lists: Healthy People 2010, MMWR Morbidity Tables, and MMWR Mortality Tables. Below the "WONDER Online Databases" list, there are sections for "Mortality" and "Population". The "Mortality" section lists: Underlying Cause of Death, Detailed Mortality, Compressed Mortality, Multiple cause of death (Detailed Mortality), Infant Deaths (Linked Birth/Infant Death Records), and Online Tuberculosis Information System. The "Population" section lists: Bridged-Race Population (from NCHS), Population (from Census), Sexually Transmitted Disease Morbidity, and Vaccine Adverse Event Reporting. At the bottom of the page, there is a note: "Denotes numerical data available to query or download".

CDC WONDER

WONDER Home FAQ Help Contact Us Search

WONDER online databases utilize a rich ad-hoc query system for the analysis of public health data. Reports and other query systems are also available.

WONDER Systems Topics A-Z Index

- **WONDER Online Databases**
 - ▶ [AIDS Public Use Data](#)
 - ▶ [Births](#)
 - ▶ [Cancer Statistics](#)
 - Environment**
 - ▶ [Daily Air Temperatures & Heat Index](#)
 - ▶ [Daily Land Surface Temperatures](#)
 - ▶ [Daily Fine Particulate Matter](#)
 - ▶ [Daily Sunlight](#)
 - ▶ [Daily Precipitation](#)
 - Mortality**
 - Underlying Cause of Death
 - ▶ [Detailed Mortality](#)
 - ▶ [Compressed Mortality](#)
 - ▶ [Multiple cause of death \(Detailed Mortality\)](#)
 - ▶ [Infant Deaths \(Linked Birth/Infant Death Records\)](#)
 - ▶ [Online Tuberculosis Information System](#)
 - Population**
 - ▶ [Bridged-Race Population \(from NCHS\)](#)
 - ▶ [Population \(from Census\)](#)
 - ▶ [Sexually Transmitted Disease Morbidity](#)
 - ▶ [Vaccine Adverse Event Reporting](#)

- **Reports and References**
- [Prevention Guidelines \(archive\)](#)
- [Scientific Data and Documentation](#)
- **Other Query Systems**
- ▶ [Healthy People 2010](#)
- ▶ [MMWR Morbidity Tables](#)
- ▶ [MMWR Mortality Tables](#)

▶ Denotes numerical data available to query or download

NLDAS-derived Heat-related Products on CDC WONDER

Now Available at <http://wonder.cdc.gov/nasa-nldas.html>



[CDC Home](#) [Search](#) [Health Topics A-Z](#)

CDC WONDER

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North America Land Data Assimilation System (NLDAS) Daily Air Temperatures and Heat Index (1979-2010) Request

Request Form

[Results](#)

[Map](#)

[Chart](#)

[About](#)

[Environmental Data](#)

[Dataset Documentation](#)

[Data Use Restrictions](#)

[How to Use WONDER](#)

[Reset](#)

Make all desired selections and then click any **Send** button one time to send your request.

1. Organize table layout:

[Send](#) [Help](#)

Group Results By

And By

And By

And By

And By

Select a temperature scale.

☒ Fahrenheit ☐ Celsius

Select Measures (Check box to include in results. Must select at least one.)

Daily Max Air Temperature (F):

☒ Avg Temperature ☒ # of Observations ☒ Range

Daily Min Air Temperature (F):

☐ Avg Temperature ☐ # of Observations ☐ Range

Daily Max Heat Index (F):

☐ Avg Heat Index ☐ # of Observations ☐ Range ☐ Percent Coverage

Title

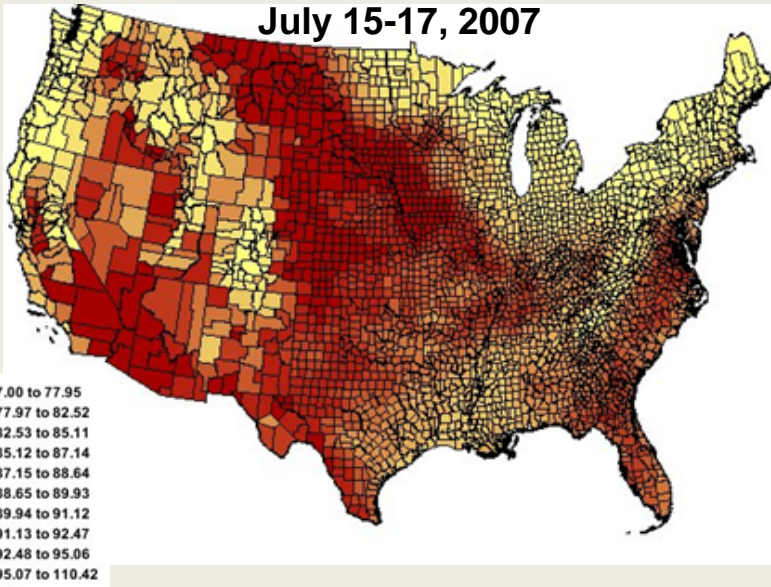
2. Select location:

[Send](#) [Help](#)

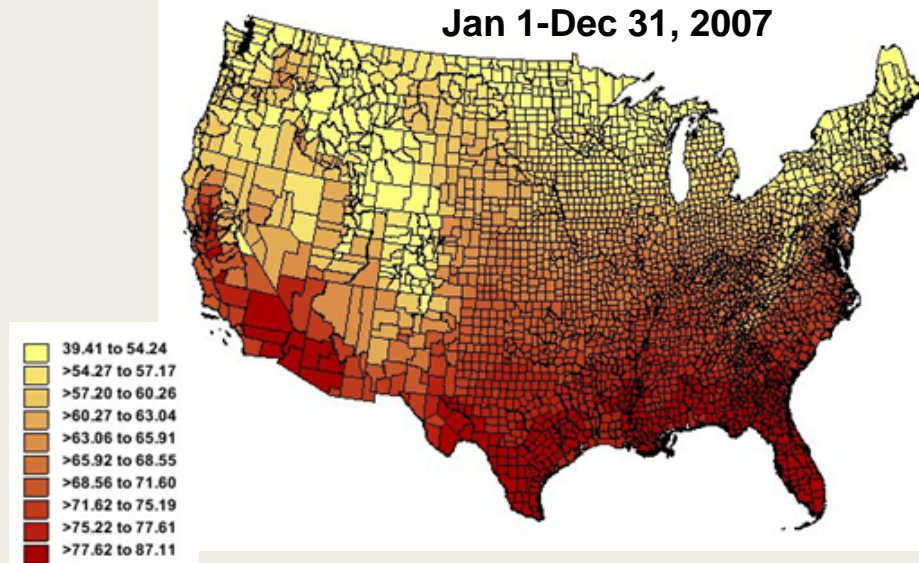
CDC WONDER Spatial/Temporal Aggregation

Avg Daily Max Air Temperature(F) for The United States

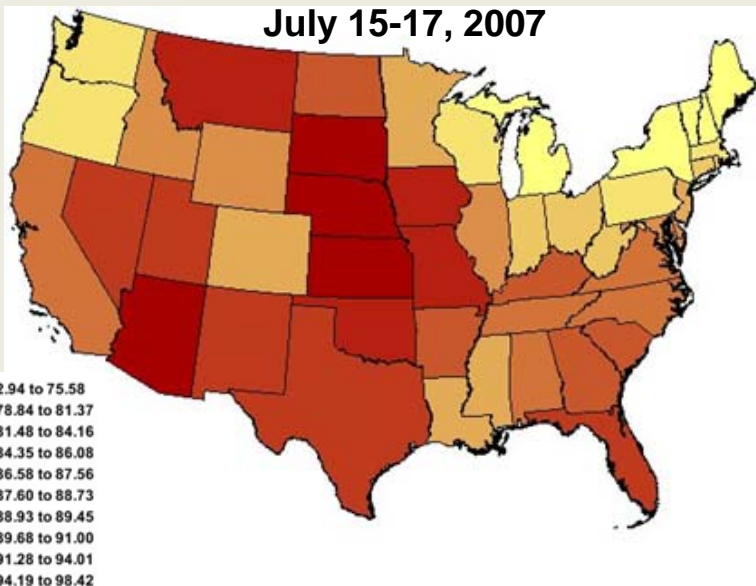
July 15-17, 2007



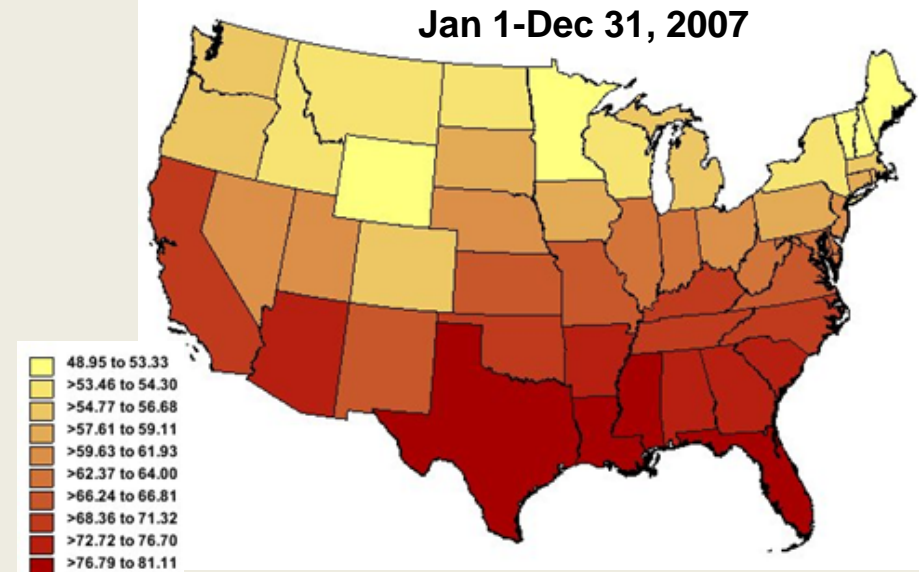
Jan 1-Dec 31, 2007



July 15-17, 2007



Jan 1-Dec 31, 2007



Summary

- Development of national daily products of PM_{2.5}, LST, maximum and minimum air temperature, maximum heat index, and solar insolation for 2003-2008
- Linkages of these data with public health data from the REGARDS national cohort study for environmental health correlation studies
- Dissemination of these environmental datasets to public health professionals, researchers and the general public via the CDC WONDER online system
<http://wonder.cdc.gov/>
- Providing a useful addition to CDC WONDER, allowing public health researchers and policy makers to better include environmental exposure data in the context of other health data available in CDC WONDER online system
- Substantially expanding public access to these NASA environmental datasets, making their use by a wide range of decision makers more feasible

Thanks!

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